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HPC-B SERIES USER MANUAL

HIGH POWER CONTROL MODULE
BURST FIRING VERSION

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1. Ordering Codes

Part#	Description
HPC-P	Phase Angle Control Module SCR GATE DRIVE (see HPC-1P User Manual)
HPC-B	Burst Firing Control Module SCR GATE DRIVE
HPC-B-LVC	Burst Firing Control Module SCR GATE DRIVE w/Line Voltage Compensation

2. Description

The HPC is a phase angle / burst fire control module designed for use with high power back to back SCR modules. The power delivered to the load is proportional to the command input signal.

Features:

- Zero Cross Firing for low EMI
- Fast Synchronous Burst Algorithm provides true linear power at fast cycle times
- Command input accepts 4-20mA, 0-10V, 0-5V, Pot, PWM
- Automatic frequency operation (45 to 65Hz)
- Adjustable Power % Limit
- Drives SCR gates directly
- Single phase and three phase control

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3. Installation

WARNING: FIRE HAZARD!! Even quality electronic components CAN FAIL KEEPING FULL POWER ON! Provide a SEPARATE (redundant) OVER TEMPERATURE SHUTDOWN DEVICE to switch the power off if safe temperatures are exceeded.

WARNING: HIGH VOLTAGE!! This control module has high voltage on it. This control must be installed in a GROUNDED enclosure by a qualified electrician in accordance with applicable local and national codes including NEC and other applicable codes. Provide a safety interlock on the door to remove power before gaining access to the device.

3.1 Mounting Instructions

The HPC mounts in a 3.0” snap track and can be installed on a dinrail.

3.2 Electrical Connections

See the WIRING DIAGRAMS at the end of this document. Make sure the module ordered is the correct module for the application before wiring. Before wiring the module all Dip Switch settings for the command input and special features should be setup properly per the Dipswitch Configuration Section.

4. Operation

4.1 Power Supply

The HPC power supply requirement is 24V AC +/-10% 47-63Hz OR 24VDC+15/-5%. The line synchronization for phase angle and certain modes of burst firing has an input voltage range of 100 to 600VAC, 30 to 90Hz.

4.2 24V Power Fusing

Fusing may be accomplished by fusing each module separately or fusing groups of the modules with either primary or secondary fusing. The current draw of each HPC is 100mA max.

4.3 Command Input

The HPC can accept 4-20mA, 0-10V, 0-5V, and Potentiometer and PWM inputs. All analog command inputs are not isolated from the 24V power Input. The type of command input can be configured via the dipswitch. The default setting is 0-5V/potentiometer.

The PWM digital command input (PLC Interface) is optically isolated from the power supply.

When wiring multiple HPC’s together, follow the guidelines in the Wiring Multiple HPCs section.

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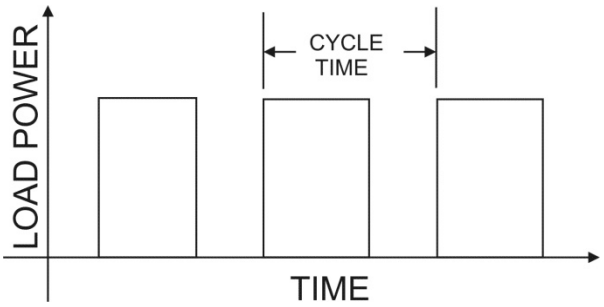
Any leg of the command input can tolerate shorts to the (0V) input. Connecting the 24V power to the command input may cause damage to the unit.

4.3.1 Input Fail-safe Protection

If the signal sent to the HPC's command input should become electrically open the control output will be forced to an off state.

4.4 Cycle Times

The cycle time refers to the total time between an on and off cycle.



The HPC -B has 4 available cycle times settable via the dipswitches.
The cycle times are specified below in # of cycles and can be correlated to their respective times using the table below for both 50 and 60 Hz Line frequencies:

Dip Switch 1	Dip Switch 2	#of cycles	Cycle Time (60Hz)	Cycle Time (50Hz)	Resolution (% of FS)
*OFF	*OFF	~16	266mS	320mS	~1%
ON	OFF	60	1S	1.2S	1.66%
OFF	**ON**	600	10S	12S	0.166%
ON	**ON**	6000	100S	120S	0.0166%

*Synchronous Firing Method
When burst firing AC with conventional PWM, there is a tradeoff between resolution and cycle time. Generally the cycle time should be chosen based on the mass of the load to be controlled; the larger the load mass, the longer the cycle time can be. For the best possible resolution, its standard practice to choose the longest cycle time that can be used without causing process ripple. Longer cycle times generally provide greater control resolution, but the Fast Synchronous Burst setting provides excellent resolution at a fast cycle time.

4.5 Cycle Times – 266mS Selection (Fast Synchronous Burst Firing)

When the HPC-B cycle time is set to 266mS (320mS @ 50Hz) the Fast Synchronous Burst Firing mode is turned on. The cycle time becomes longer near zero and full power levels to provide improved control resolution. For Example, since the HPC -1B generally modulates 16 AC cycles, the lower limit in power that will maintain the cycle time is 1/16 or 6.25%. The HPC-B will use increased off periods below 6.25% power and above 94.75% power.

4.5.1 Fast Synchronous Burst Firing Mode

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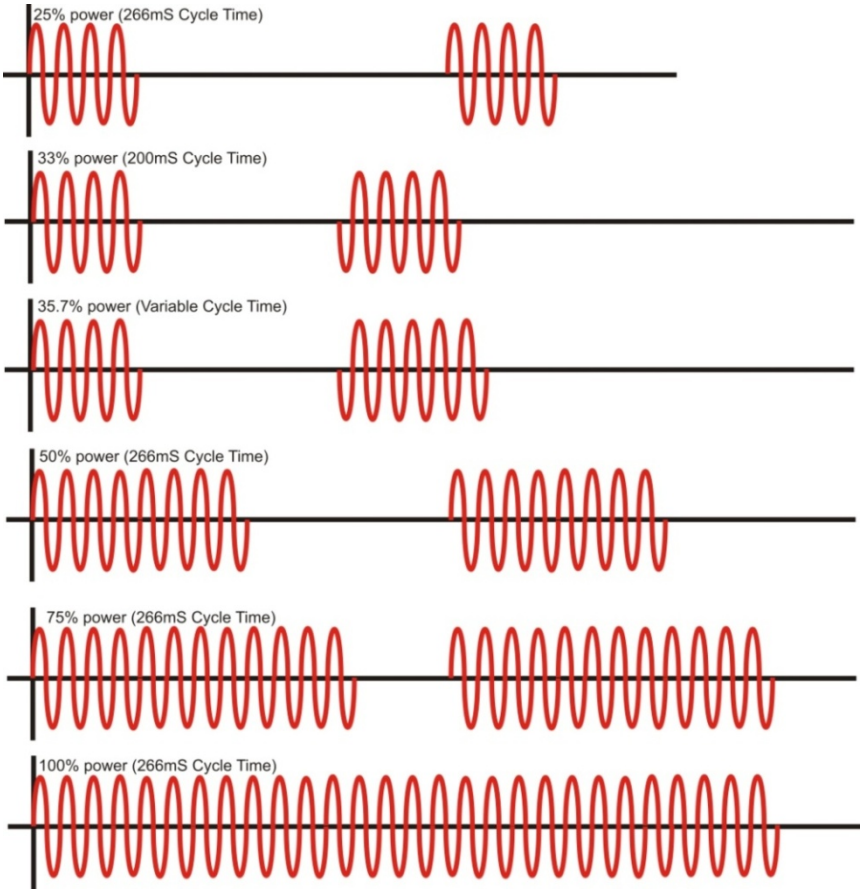
As shown below, the HPC-B's Fast Synchronous Burst Firing mode selectively fires fractional numbers of cycles. Since pulse width modulation alone would limit the resolution to 16 steps or 6.25% when modulating 16 AC cycles, a proprietary algorithm is employed to provide improved resolution of 0.5-1%. In this firing mode, the cycle time is varied as well as the on time. To select the Fast Synchronous Burst Firing Mode set Diswitches 1 and 2 to the off position.


25% power (266mS Cycle Time)
33% power (200mS Cycle Time)
35.7% power (Variable Cycle Time)
50% power (266mS Cycle Time)
75% power (266mS Cycle Time)
100% power (266mS Cycle Time)

4.5.2 Fast Synchronous Burst Firing Advantages

The two plots below are actual data for a 425 degF capable 10KW resistive heater ramped from 0-100% power over two hours. The first plot shows straight 16 cycle, 266mS cycle time PWM. Note the nonlinearity humps due to poor resolution. The second plot shows the linearity improvement with the Fast Synchronous Burst. Any visible overall curvature is a normal heater characteristic.

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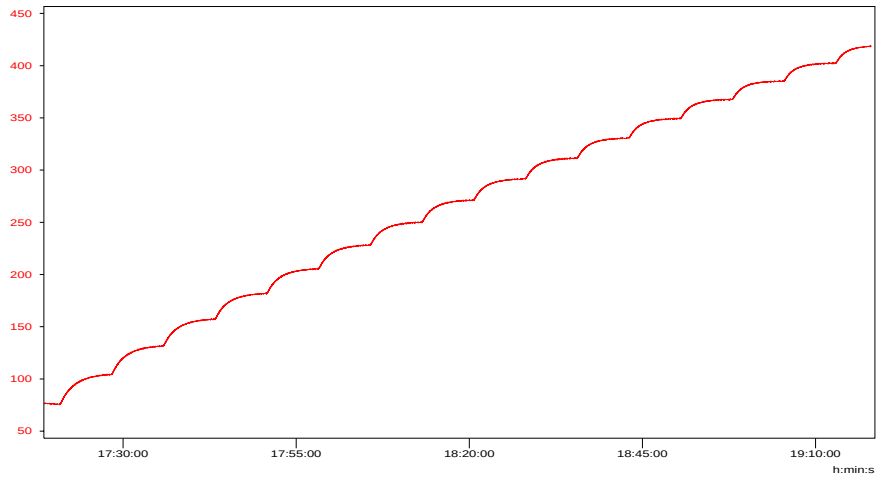
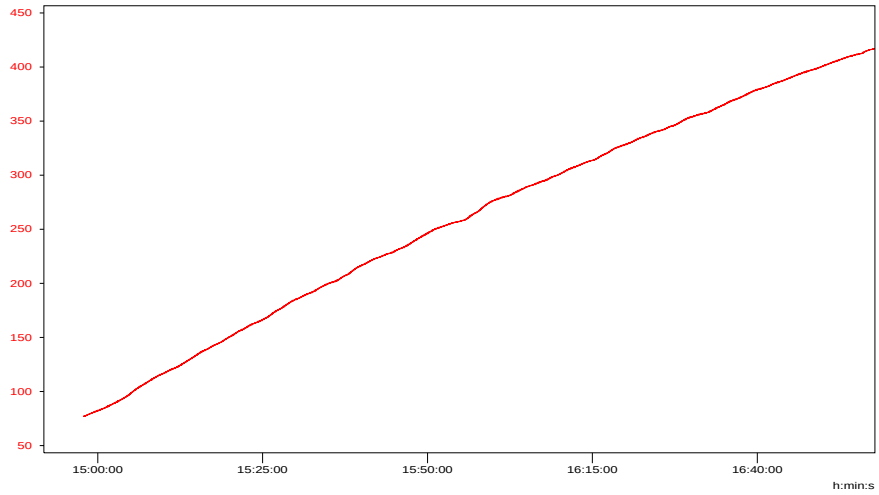


Fast PWM of zero cross fired loads can result in poor linearity / resolution (above)



Fast Synchronous Burst algorithm results in excellent linearity / resolution (above)

4.6 Line Voltage Compensation (-LVC Option)

The HPC's line voltage compensation keeps the power constant on the load as the line voltage changes. The line voltage is measured via the 24V power applied to the HPC module. To use the Line Voltage Compensation feature properly, a 24VAC power transformer should be fed from the same mains as the load circuit to be controlled as per the wiring diagrams at the end of this document. Line Voltage Compensation can be enabled or disabled using the configuration dipswitch. The default setting is enabled (Switch # 1 is OFF). To disable the Line Voltage Compensation, set switch # 1 to the ON position.

On the HPC-B, Line Voltage compensation can be ordered by adding –LVC to the suffix of the part #. When line voltage compensation is specified, only the fast synchronous burst cycle time is available (the dipswitch setting of cycle times is disabled).

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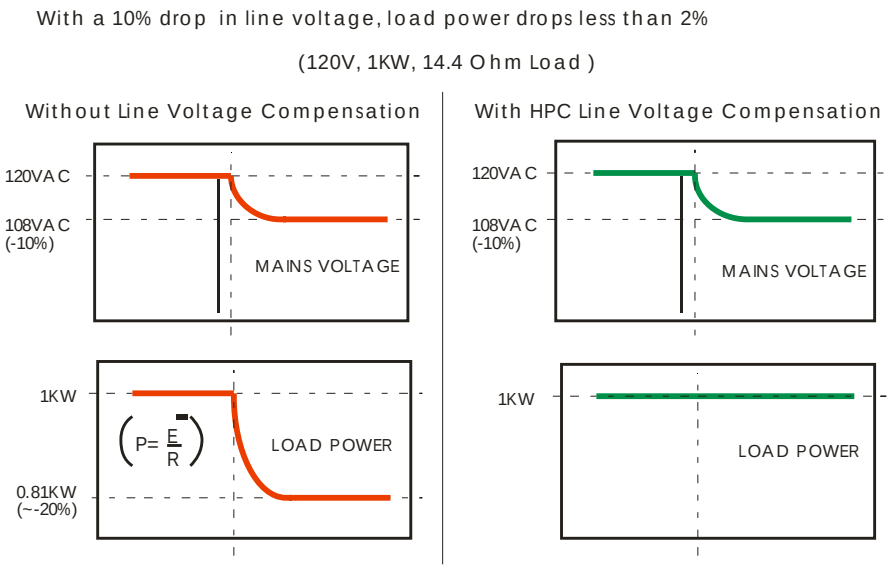

4.6.1 Line Voltage Compensation Nominal Adjustment

The nominal adjustment pot sets the nominal level of output for the current line voltage being measured via the 24VAC input.

4.7 Power Limit

The Power Limit feature is used in conjunction with the Line Voltage Compensation feature to limit the actual voltage delivered to the load. The Power Limit is adjustable via a potentiometer located just below the input terminal block. For this feature to work properly Line Voltage Compensation must be turned on and the power transformer for the HPC must be connected to the same mains as the load power is connected to. This feature can be used without Line Voltage Compensation and will simply clip the command signal to a set level.

4.7.1 Power Limit Adjustment Procedure

The Power Limit is adjustable from 5% to 100% of the max power. Setting the Power Limit potentiometer half way corresponds to a Power limit of approximately 55%. With the command input set to approximately 100% (on startup) turn the pot fully CCW. Then just turn the pot CW until the desired maximum output Power is achieved. For this feature to work as a true max limit, it is important that the Line Voltage Compensation be enabled (this is the OFF position of Switch # 1).

If the line voltage compensation is set to OFF or not present in the ordering code, the max limit will act as a percentage of output limit and the absolute max limit will change with line voltage.

4.8 Configuration Dipswitch

The configuration dipswitch is used for setting up the command input and Cycle Times. Using a pen point gently push the switch up for on and down for off according to the setup outlined in the table below.

Command Input	4	5	6
0-5V (Default)	OFF	OFF	OFF
Potentiometer	OFF	OFF	OFF

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0-10V	OFF	OFF	**ON**
4-20mA	**ON**	**ON**	OFF
1-5V	OFF	**ON**	OFF
2-10V	OFF	**ON**	**ON**

4.9 Output LED

The HPC's RED output LED will turn on when the output is on the LED should can used as a rough indication of SCR Drive and actual power output.

4.10 Three Phase Operation

Three HPCs can be used to control three poles of a three phase load for inside delta, or grounded WYE configurations. The Module should be wired as shown in the wiring diagrams.

4.11 Wiring Multiple Units in Single Phase or Three Phase Applications

If more than one HPC is to be used from a non-isolated or common command signals:

1. A common power supply or transformer can be shared. If the input selected is 0-10V or 0-5V, the inputs should be wired in parallel.
2. If multiple units must be powered from one power transformer and 4-20mA input is selected, one module should be set for 4-20mA and the remaining modules should be set for 1-5V and wired in parallel.
3. If the command is 4-20mA, and the command inputs are to be wired in series, a separate power transformer or supply for each module is required to isolate the inputs.

4.11.1 Connecting Power & Commands In Parallel

When multiple HPC power inputs and commands are wired in parallel, all of the 0V terminals must be connected together follows:

Power:	Command:
0V-----0V-----0V----->	0V-----0V-----0V----->
24V---24V---24V---->	IN------IN-----IN------>

No crossing of the power input feed or command signal is permitted. If for some reason the power should become crossed, it will cause a direct short in the system. If properly fused, the fuse will blow and the HPC will not be damaged. If the command inputs are wired improperly, damage to the HPC can result.

5. Electrical Specifications

Command Inputs	4-20mA, 0-10V, 0-5V, Pot, PWM
Input Impedance	10K Ω (0-10V), 250Ω (4-20mA), 100KΩ (0-5V)
Response Time	<50mS
Output Linearity	<+/-2%
External Potentiometer Res.	10KΩ-25KΩ
Line Voltage Comp. Range	+15%/-15% up to 100% output
Power Limit Range	5-100% of max load voltage.
Ambient Temperature Range	0 to 50 °C
Power Supply	24VAC/DC +10/-10%, <100mA Current Draw.
Line Frequency Range	45 to 65Hz
Line Voltage Range	100-600VAC
SCR Firing	AC Zero Cross Fired.

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SCR Gate Drive Characteristics	16KHz Burst for 2mS every half cycle. Initial pulse peak current of 600mA, maintain pulses, 300mA, 10uS pulse width per pulse, rise time of 100nS.

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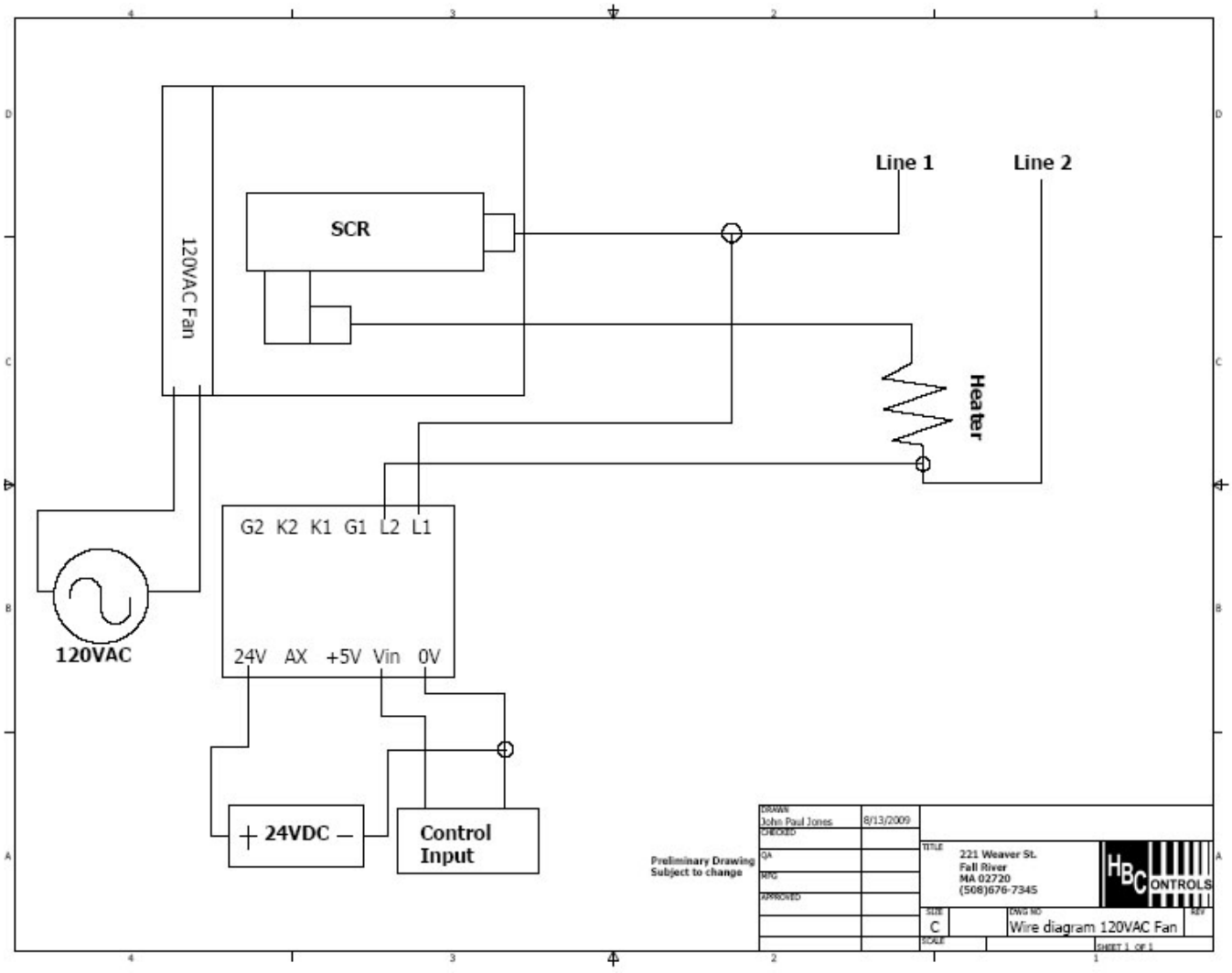
6. Mechanical Dimensions

7. WIRING DIAGRAM -



8. Contact Information

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